Jan. 15, 1963 J. P. ELLSWORTH ETAL 3,073,926

CIRCUIT BREAKER

Filed Oct. 16, 1959

3 Sheets-Sheet 1

Fig. 1.

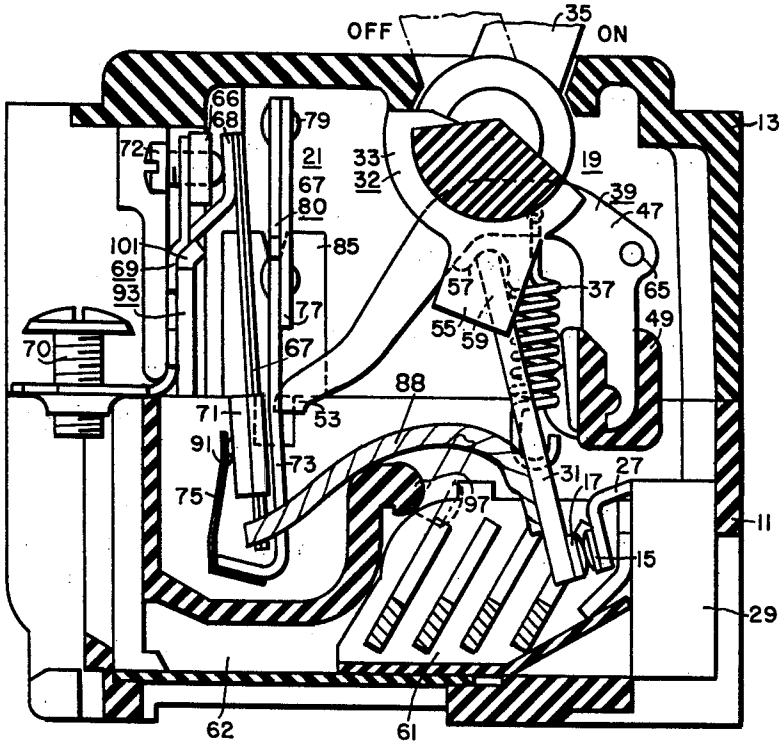
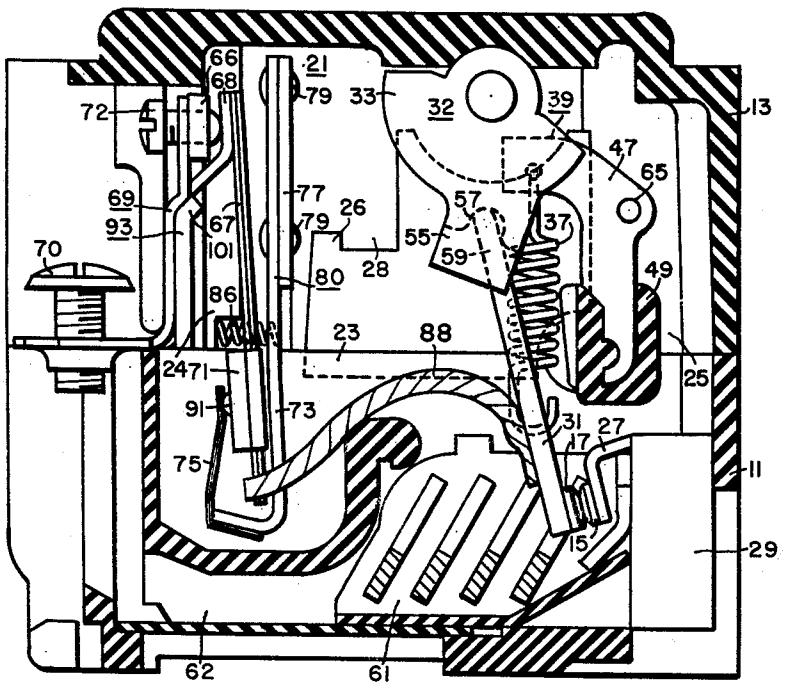


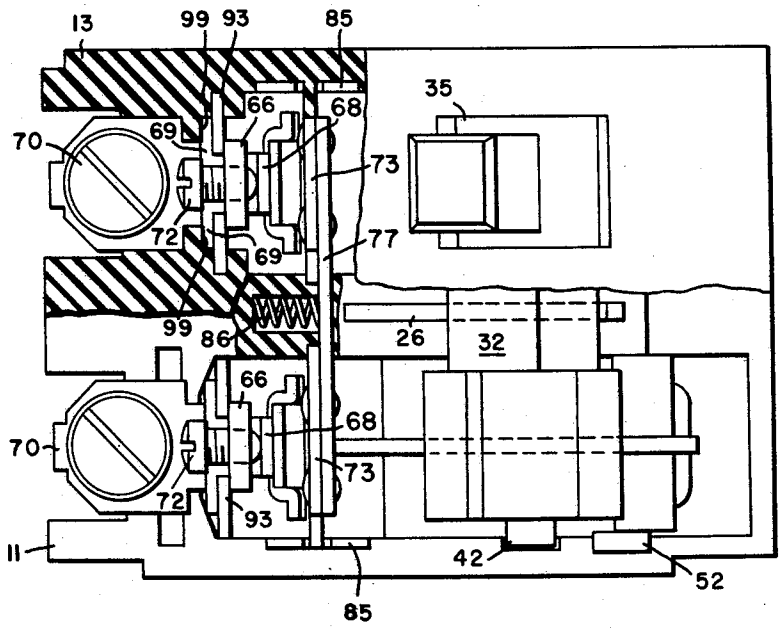
Fig. 2.



CIRCUIT BREAKER

Filed Oct. 16, 1959 3 Sheets-Sheet 2

Fig. 3



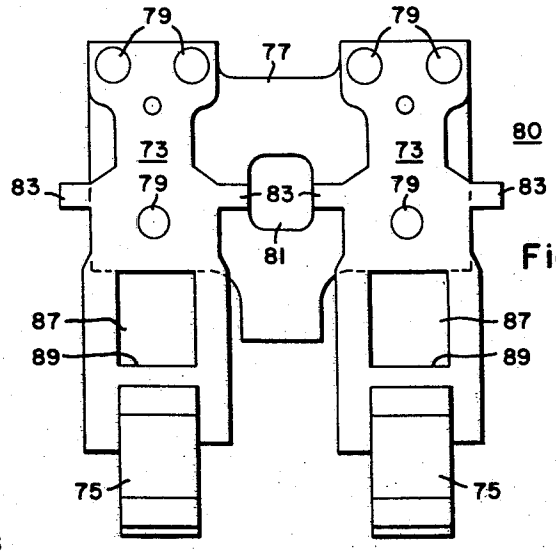


Fig. 4

WITNESSES

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Jan. 15, 1963 J. P. ELLSWORTH ETAL 3,073,926

CIRCUIT BREAKER

Filed Oct. 16, 1959 3 Sheets-Sheet 3

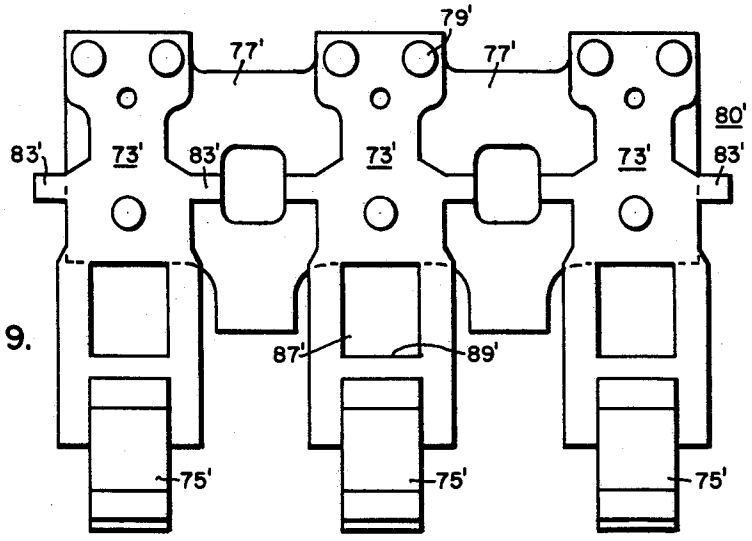


Fig. 9.

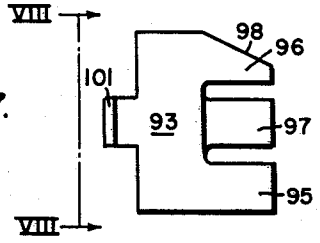


Fig. 7.

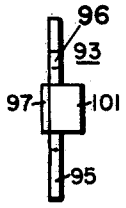


Fig. 8.

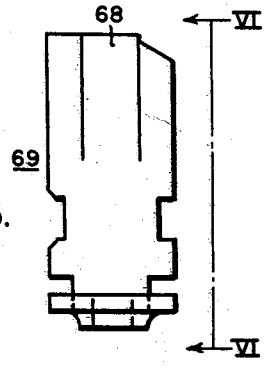


Fig. 5.

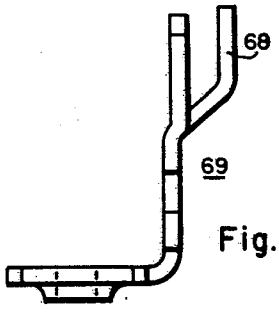


Fig. 6.

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3,073,926

CIRCUIT BREAKER

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Filed Oct. 16, 1959, Ser. No. 846,939
8 Claims. (Cl. 200—88)

This invention relates to circuit breakers and, more particularly, to circuit breakers which are manually opened and closed and which are opened automatically upon the occurrence of an overload current.

An object of the invention is to provide a multi-pole circuit breaker embodying an improved trip mechanism.

Another object of the invention is to provide a multi-pole circuit breaker embodying an improved thermally and magnetically responsive trip device wherein there is provided an armature for each pole unit and insulating means connecting said armatures whereby said armatures and said insulating means function as a trip member common to all of the pole units.

Another object of the invention is to provide a multi-pole circuit breaker embodying an improved thermally and magnetically responsive trip device having, for each pole unit, an armature with ambient temperature compensating means attached thereto, and insulating means rigidly connecting al of the armatures as a common trip member so that movement of any one of the armatures effects automatic tripping of all of the pole units.

In accordance with one embodiment of the invention, a multi-pole circuit breaker is provided with a set of separable contacts and a trip device for each pole unit. Each trip device includes a bimetal element, a magnet, an armature and a compensating bimetal element. The bimetal element is supported at one end and the magnet is attached to the bimetal element near the free end thereof. The armature is pivotally supported having one side adjacent the magnet, and the compensating bimetal is attached to the armature and extends adjacent the side of the magnet which is opposite the side which faces the armature. The armatures for all of the pole units are rigidly connected by insulating means so that movement of any one of the armatures will effect movement of all of the armatures and release of a trip arm which is latched by one of the armatures. Release of the trip arm effects automatic opening of all of the sets of separable contacts. Upon the occurrence of an overload current below a predetermined value in any pole unit, the bimetal deflects and because of the engagement of the magnet with the compensating bimetal element, the armature is pivoted effecting release of the trip arm and all of the circuit breaker pole units are automatically opened with a time delay. The compensating bimetal effects compensation for movement of the bimetal element in response to changes in ambient temperature. Upon the occurrence of an overload current above the predetermined value in any one pole unit, the armature is attracted to the magnet member to effect instantaneous release of the trip arm.

The bimetal element is connected to and supported by a terminal conductor that extends into the circuit breaker housing. The outer end of the terminal conductor is often physically moved during normal circuit breaker use, especially when the terminal is being connected or disconnected. It is importaant that the inner portion of the terminal conductor be positively positioned so that it cannot move to disturb the calibration of the trip device. In the past this inner portion of the terminal conductor has been secured to the circuit breaker housing by means of a positioning screw.

Another object of this invention is to provide a circuit breaker embodying improved positive positioning means for holding the terminal conductor in position.

Another object of this invention is to provide a circuit breaker embodying a positive positioning member having a resilient portion biasing the terminal conductor against an inner surface of the breaker housing to hold the conductor firmly in place.

A further object is to provide a circuit breaker embodying a positive positioning member for exerting pressure against the terminal conductor to hold it in place in the circuit breaker which positioning member has a bimetal portion that flexes upon being heated to strengthen the holding force of the positive positioning member.

The invention both as to structure and operation, together with additional objects and advantages thereof, will be best understood from the following detailed description when read in conjunction with the accompanying drawings.

In said drawings:

FIGURE 1 is a vertical sectional view illustrating one pole unit of a two-pole circuit breaker embodying the principles of this invention;

FIG. 2 is a vertical sectional view similar to FIG. 1 showing the other pole unit of the duplex circuit breaker;

FIG. 3 is a plan view with parts broken away of the circuit breaker shown in FIGS. 1 and 2;

FIG. 4 is an elevational view of the common trip member of the two-pole circuit breaker of this invention;

FIG. 5 is an elevational view of the load terminal conductor for one of the pole units;

FIG. 6 is a view taken along the line VI—VI of FIG. 5;

FIG. 7 is an elevational view of the positive positioning member of one of the pole units;

FIG. 8 is a view taken along line VIII—VIII of FIG. 7; and

FIG. 9 is an elevational view of a common trip member similar to the trip member shown in FIG. 4, but modified for use in a three-pole circuit breaker.

Referring to FIG. 1 of the drawings, the ciruit breaker generally comprises a two piece housing of molded insulating material including a base **11** and cover **13**, a stationary contact **15** and movable contact **17** for each pole of the breaker, an operating mechanism indicated generally at **19** and a trip device indicated generally at **21**. The housing is divided substantially into two separate compartments by means of a barrier **23** molded integral with the base **11**, and barriers **24**, **25** and **26**. The barriers **24** and **26** are molded integral with the cover **13**, and the barrier **26** interlocks with the barrier **23** to substantially close an opening **28** between the compartments which opening exists so that the breaker may be easily assembled.

The stationary contacts **15** for each of the two poles of the circuit breaker are mounted on the inner ends of conducting members **27** which are integral with plug-in connectors **29** supported in the base **11** of the circuit breaker housing. The moving contact **17** for each pole unit is rigidly secured to a U-shaped switch or contact arm **31**. Both of the contact arms **31** (FIGS. 1 and 2) are operated to open and closed positions by the single operating mechanism **19**.

The operating mechanism **19** comprises an operating member **32** having an integral operating lever **33**, an over-center spring **37** and a releasable trip member **39**. A single operating handle **35** (FIG. 1) is molded integral with the operating member **32**. The operating member **32** including the handle **35** and the operating levers **33** for both poles of the breaker comprises a single member of molded insulating material so that operation of the handle **35** simultaneously moves both of the levers **33**.

The operating member **32** has a central bearing surface for pivotally supporting the member in the barrier **26** (FIGS. 2 and 3). Bearing surfaces **42** (only one being shown in FIG. 3) on the ends of the member **32** are provided for pivotally supporting the ends of the member in recesses in the side walls of the cover **13**.

The releasable trip member **39** (FIGS. 1 and 2) comprises a spring support portion **47** for each of the poles of the breaker, each of which is secured adjacent its pivot axis to a tie rod or cross bar **49** of molded insulating material for unitary pivotal movement. The tie rod **49** is provided with end bearing portions **52** (FIG. 3) for supporting the ends of the releasable trip member **39** in bearing supports in the side walls of the cover **13** and base **11**. The spring support portion **47** for one of the poles of the breaker extends toward the left (FIG. 1) and has a latch end **53** which is normally engaged and releasably held by a single latch element of the trip device **21** (to be later described) to releasably hold both of the spring support portions **47** of the releasable trip member **39** in operative position.

Each of the operating levers **33** is bifurcated and the spaced legs **55** thereof are provided with notches **57** in which are seated and pivoted the outer or upper ends of the legs **59** of the U-shaped switch members **31**. The switch members **31** are held in place by the overcenter operating springs **37** which are connected under tension between the switch members **31** and the corresponding spring support portions **47** of the releasable trip member **39**. As shown in FIGS. 1 and 2, the springs **37** bias the switch members **31** to the closed position.

The circuit breaker is opened manually by moving the handle **35** (FIG. 1) counterclockwise from the position in which it is shown in solid lines to the position in which it is shown in dot and dash lines. During this movement the outer or upper ends of the switch arms **31** are carried over to the right of the line of action of the overcenter springs **37** whereupon the springs move the switch arms to the open position with a snap action. The contacts are closed by reverse movement of the operating handle **35**, that is, from the position in which the handle **35** is shown in dot and dash lines in FIG. 1 to the position in which it is shown in solid lines. During this movement, the outer or upper ends of the switch members **31** are moved over to the left of the line of action of the overcenter springs which then move the switch members to the closed position with a snap action.

An arc extinguisher **61** is disposed in a recess or arc chamber in the base **11** for each pole of the breaker for quickly extinguishing the arc drawn when the circuit is interrupted. The arc extinguishers may be of any suitable type, each of those shown comprising a series of spaced slotted plates of magnetic material into which the arc is drawn and quickly extinguished. The arc gases for each pole are drawn into a passage **62** along the bottom of the base **11** and vented out the end of the housing opposite the stationary contacts.

The circuit breaker is tripped open automatically upon release of the latch end **53** of the trip member **39**. As soon as the releasable trip member **39** is released, the springs **37** for both poles of the breaker rotate the trip member **39** including the spring support portions **47** for each pole, in a counterclockwise direction, until the trip member is arrested by its engagement near the latch end **53** of the extended spring support portion **47** with a projection **97** molded integral with the base **11** of the circuit breaker housing. This movement of the releasable trip member **39** carries the line of action of the springs **37** for both poles of the circuit breaker over to the left of the pivots at **57** of the associated switch members **31**, and the springs **37** then move the switch members to the open position with a snap action. When the springs **37** move overcenter, they act through the switch members **31** to move the handle **35** to an indicating position between the "on" and "off" positions, giving a visual indication that both poles of the circuit breaker have been tripped open.

Before the contacts can be closed following an automatic opening operation, it is necessary to reset and relatch the mechanism. This is accomplish by moving the handle **35** and the operating member **32** to a position slightly beyond the "off" position. During this movement the legs **55** of the levers **33** engage a pin **65** in the releasable trip members **47** and restore the entire releasable trip member **39** for both of the poles to the latched position. The contacts are then closed in the previously described manner by movement of the handle **35** and the levers **33** to the "on" position.

The trip member **39** is released, to effect automatic opening of the contacts, by operation of the thermal magnetic trip device **21**. The trip device **21** for each pole unit of the circuit breaker includes a bimetal **67** which is welded or otherwise attached to the central portion **68** of a terminal conductor **69**. A magnet **71** is secured to each bimetal **67** adjacent the free end thereof. An armature **73** having a compensating bimetal member **75** attached to the lower end thereof, is provided for each pole unit. Each compensating bimetal **75** extends adjacent the side of the magnet which is opposite the side which faces the armature **73**. The armatures **73** for both of the pole units are rigidly connected by insulating means **77** so that movement of any one of the armatures will effect movement of all of the armatures and release of the trip arm **39** which is latched by only one of the armatures. As best seen in FIGS, 1, 2 and 4, each of the armatures **73** is riveted to an insulating plate **77** by means of rivets **79**. The combination of the two armatures **73** and the insulating connecting plate **77** will be hereinafter referred to as a common trip member **80** because it moves as a unit to effect release of the trip member **39** and automatic opening of the contacts for each of the pole units of the circuit breaker. Each of the armatures **73** has two arms **83** extending from the sides thereof. The outer arms **83** of the armatures are pivotally supported in V-shaped slots in metallic pivot plates **85** (only one being shown in FIG. 1), and the common trip member **80** is pivotally supported thereby. As best illustrated in FIG. 3, the metallic pivot plates **85** are supported in notches in the insulating housing. An opening **81** exists in the insulating plate **77** to provide electrical clearance between the inner arms **83** of the armatures **73**. A spring **86** disposed in a recess in the barrier **24** of the housing cover **13**, biases the common trip member **80** in a counterclockwise direction.

When the circuit breaker is in the closed position, the circuit for each pole unit extends from the plug-in connector **29** through the conducting member **27**, separable contacts **15** and **17**, contact arm **31**, a flexible conductor **88** which is welded at one end to the contact arm **31** and at the other end to the bimetal **67**, the bimetal member **67** to the terminal conductor **69**.

As is best illustrated in FIG. 4, each of the armatures **73** has a rectangular shaped opening **87** forming a lower ledge **89**. The lower ledge **89** of the armature on the left as viewed in FIG. 4, holds the latch end **53** (FIG. 1) of the trip member **39** when the parts are in a latched position. Although only one of the armatures **73** actually supports the trip member **39**, they are of identical construction because they are stamped from the same die.

Upon the occurrence of an overload current below a predetermined value in any pole unit, the bimetal **67** for that pole unit deflects to the left as viewed in FIGS. 1 and 2, and an insulating button **91** on the magnet **71** engages the compensating bimetal **75** for that pole unit, so that movement to the left of the bimetal **67** effects clockwise pivotal movement of the common trip member **80** and release of the trip member **39** to effect automatic opening of the contacts for both of the circuit breaker pole units.

The compensating bimetal **75** for each pole unit, is provided to compensate for movement of the bimetal element **67** in response to changes in ambient temperature. The high expansion sides of the bimetals **67** and **75** are

on the right as viewed in FIGS. 1 and 2, so that upon deflection of any of the bimetals 67 to the left in response to a rise in ambient temperature, the bimetal 75 associated therewith will deflect the same amount to the left providing that there will be no substantial unlatching movement of the common trip member 80 and therefore no loss of latch engagement between the latch end 53 of the trip member 39 and the latching surface 89 of the armature 73. If the ambient temperature should then drop the bimetal 67 deflects to the right and the bimetal 75 deflects to the right the same amount to compensate for this movement of the bimetal element 67.

Upon the occurrence of an overload current above the predetermined value in any one pole unit, the magnet member 71 for that pole unit, is energized sufficiently to attract the armature 73 which is associated therewith, effecting clockwise movement of the common trip member 80 and instantaneous release of the trip member 39 to effect automatic opening of the contacts for both of the pole units. A common magnet and coil arrangement may be attached to each bimetal 67 in place of each magnet 71 to increase the speed of magnetic tripping as is well known in the art.

In each pole unit, the bimetal element 67 is welded or otherwise attached at its upper end to the central portion 68 of the associated terminal conductor 69 (FIGS. 5 and 6). The thermal tripping time is adjusted by means of a screw 72 (FIGS. 1, 2 and 3) in each pole unit, which threadedly engages a supporting member 66. The rounded inner end of the screw 72 applies a pressure to the central portion 68 of the terminal conductor 69. Turning the screw 72 varies the pressure applied to the terminal conductor central portion 68 thereby varying the position of the bimetal 67 in the associated pole unit. Variance of the position of any of the bimetals 67, through the associated compensating bimetal 75, effects variance of the amount of latch engagement between the latch end 53 of the trip member 39 and the lower ledge or latching surface 89 of one of the armatures 73, and therefore, affects the thermal tripping time.

A connecting screw 70 is provided in each pole unit for connecting the terminal conductor 69 for that pole unit in an electric circuit. The outer end of the terminal conductor 69 is often physically moved during normal circuit breaker use especially when the terminal is being connected or disconnected. It is important that the inner portion of the terminal conductor 69 be positively positioned so that any movement of the outer portion will not be transmitted to the inner portion to disturb the calibration of the trip device 21 or to effect a false tripping operation.

A positive positioning member 93 (FIGS. 7 and 8) is provided for each pole unit of the circuit breaker. Referring to FIG. 3, the circuit breaker insulating cover 13 has two slots molded integral therewith for each of the pole units for receiving and supporting the positive positioning member 93. The slots are not shown for the lower pole unit as viewed in FIG. 3, because the complete cover portion 13 is broken away for this pole unit. Referring to FIGS. 7 and 8, each of the positive positioning members 93 has two outer leg portions 95 and 96, and a center portion 97 that is stamped to a position where it extends out of the plane in which the two outer leg portions are disposed (FIG. 8). The leg portion 96 is cut away at 98 to provide electrical clearance between the pole units. The stamped out center portion 97 for each of the positioning members 93, is resilient and flexible so that when the parts are in place, the resilient portion 97 biases against the associated terminal conductor 69 forcing the conductor 69 against two inner surfaces 99 (FIG. 3) molded integral with the circuit breaker cover 13. There are two inner surfaces 99 molded with the cover 13 for each pole unit; but as viewed in FIG. 3, the surfaces 99 can be seen only in the upper pole unit because the cover 13 is broken completely away for the lower pole unit. An upper wedging portion 101, of each positioning member 93, is provided to bias against the central portion 68 of the associated terminal conductor 69 to force the central portion 68 against the associated adjusting screw 72. When the parts are in place, the biasing forces of the resilient portion 97 and the wedging portion 101, of each positioning member 93 against the associated terminal conductor 69, provide that the inner portion of that terminal conductor 69 will be stationary, and that the calibration of the trip device 21 will not be disturbed even when the circuit breaker is being connected or disconnected.

In a modification of the positioning member 93, the center portion 97 thereof, is bimetallic. Upon being heated by current flowing through the terminal conductor 69, the bimetal portion 97 of the modified positioning member 93, flexes increasing the bias against the terminal conductor 69 to assure more positive positioning when current is flowing through the circuit breaker.

While a two-pole circuit breaker has been specifically described, a three-pole breaker is readily provided by making a housing having three compartments instead of the two compartments shown and adding another pole unit like the one shown in FIG. 2. The extended trip arm 47 with the latching portion 53 thereon, would be positioned preferably in the center pole. FIG. 9 illustrates a common trip member for use in a three-pole breaker. This common trip member indicated generally at 80' comprises three armatures 73' connected to function as a unit by two insulating plates 77' which plates are riveted at 79' to the armatures 73'. Each of the armatures 73' has a bimetal member 75' attached thereto. The two outer arms 83' are provided to pivotally support the common trip member 80' on metallic side plates which are not shown; but which are identical in construction to the plate 85 of FIG. 1. The operation of the three-pole circuit breaker is substantially the same as the specifically described operation of the two-pole circuit breaker.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes in the structural details and arrangement of parts thereof may be made without departing from the spirit of the invention.

We claim as our invention:

1. A multipole circuit breaker comprising, in combination, a set of separable contacts for each pole unit, latched means common to all of said pole units and releasable to effect automatic separation of all of said sets of contacts, a metallic pivot supported at each side of said circuit breaker, a common trip member pivotally supported by said metallic pivots and latching said latched releasable means, means biasing said common trip member to a latching position, said common trip member comprising an armature for each of said pole units and insulating means rigidly connecting said armatures, portions of the outer of said armatures engaging in said metallic pivots to pivotally support said common trip member, magnetic means for each of said pole units associated with each of said armatures, and the magnetic means for any one of said pole units upon energization by an overload current above a predetermined value attracting the armature associated therewith causing said common trip member to pivot against the bias of said biasing means to release said latched releasable means.

2. In a circuit breaker, an enclosing housing of molded insulating material, a circuit breaker mechanism enclosed by said housing comprising separable contacts and means releasable to effect automatic separation of said contacts, a terminal conductor extending into said housing and along an inner surface of said housing, a tripping member supported by said terminal conductor and moving to effect release of said releasable means, a positive positioning member, means supporting said positive positioning member within said housing, and said positive positioning

member having a resilient portion engaging and biasing said terminal conductor against said inner surface to positively position said terminal conductor.

3. A circuit breaker including, in combination, an enclosing housing of molded insulating material, a circuit breaker mechanism within said housing comprising relatively movable contacts and means releasable to effect automatic opening of said contacts, a terminal conductor extending into said housing and along an insulating surface in said housing, a tripping member supported by said terminal conductor and movable to effect release of said releasable means, a positioning member having a resilient portion thereon, means molded integral with said housing defining slots within said housing, said slots receiving and supporting said positioning member, and said resilient portion engaging said terminal conductor and exerting pressure against said terminal conductor to prevent movement of said terminal conductor within said housing.

4. A circuit breaker comprising, in combination, a housing of molded insulating material, a circuit breaker mechanism enclosed by said housing comprising separable contacts and means releasable to effect automatic separation of said contacts, a terminal conductor extending into said housing along an inner surface of said housing, an armature supported within said housing and movable to effect release of said releasable means, a bimetal member attached at one end to said terminal conductor and having the other end free, a magnet member attached to said bimetal member adjacent the free end thereof, said magnet member upon energization by overload currents above a predetermined amount attracting said armature causing said armature to move and effect release of said releasable means, said bimetal member in response to overload currents below said predetermined amount bending to effect movement of said armature to effect release of said releasable means, a positioning member having a resilient portion thereon, means molded integral with said housing defining slots in said housing, said slots receiving and supporting said positioning member, and said resilient portion engaging said terminal conductor and biasing said terminal conductor against said inner surface to prevent movement of said terminal conductor within said housing.

5. A circuit breaker including, in combination, an enclosing housing of molded insulating material, a circuit breaker mechanism within said housing comprising relatively movable contacts and means releasable to effect automatic opening of said contacts, a terminal conductor extending into said housing and along an insulating surface in said housing, a tripping member supported by said terminal conductor and movable to effect release of said releasable means, a positioning member having a bimetal portion thereon, means molded integral with said housing defining slots within said housing, said slots receiving and supporting said positioning member, said bimetal portion engaging said terminal conductor and exerting pressure against said terminal conductor to prevent movement of said terminal conductor within said housing, and said bimetal portion upon being heated bending and increasing the pressure exerted against said terminal conductor.

6. A circuit breaker comprising, in combination, a housing of molded insulating material, a circuit breaker mechanism enclosed by said housing and comprising separable contacts and means releasable to effect automatic separation of said contacts, a terminal conductor extending into said housing along an inner surface of said housing, an armature supported within said housing and movable to effect release of said releasable means, a bimetal member attached at one end to said terminal conductor and having the other end free, a magnet member attached to said bimetal member adjacent the free end thereof, said magnet member upon energization by overload currents above a predetermined amount attracting said armature causing said armature to move and effect release of said releasable means, said bimetal member in response to overload currents below said predetermined amount bending to effect movement of said armature to effect release of said releasable means, a positioning member having a resilient bimetal portion thereon, means molded integral with said housing defining slots in said housing, said slots receiving and supporting said positioning member, and said resilient bimetal portion engaging said terminal conductor and biasing said terminal conductor against said inner surface to prevent movement of said terminal conductor within said housing, and said bimetal portion upon being heated flexing and increasing the bias exerted against said terminal conductor.

7. In a multipole circuit breaker, an enclosing housing of molded insulating material, a multipole circuit breaker mechanism enclosed by said housing, said multipole circuit breaker mechanism comprising a set of separable contacts for each pole unit, means releasable to effect automatic separation of all of said sets of contacts, a trip member common to all of said pole units and movable to release said releasable means, said common trip member comprising an armature for each of said pole units and insulating means connecting said armatures, a tripping member for each pole unit having magnetic means thereon for attracting the armature in the same pole unit to effect movement of said common trip member and release of said releasable means, a terminal conductor for each pole unit extending into said insulating housing, each of said tripping members being supported by the terminal conductor which is positioned in the same pole unit, a positive positioning member for each of said pole units, means supporting said positive positioning members within said housing, and each of said positive positioning members having a resilient part engaging and biasing the terminal conductor in the same pole unit against an inner surface of said housing to prevent movement within said housing of the terminal conductor in the same pole unit.

8. A multipole circuit breaker comprising in combination, a set of separable contacts for each pole unit, latched means common to all of said pole units and releasable to effect automatic separation of all of said sets of contacts, a metallic pivot supported at each side of said circuit breaker, a common trip member pivotally supported by said metallic pivots, said common trip member comprising an armature for each of said pole units and insulating means rigidly connecting said armatures, portions of the outer of said armatures engaging in said metallic pivots to pivotally support said common trip member, means on one of said armatures latching said latched releasable means, means biasing said common trip member to a latching position, magnetic means for each of said pole units associated with each of said armatures, and the magnetic means for any one of said pole units upon energization by an overload current about a predetermined value attracting the armature associated therewith causing said common trip member to pivot against the bias of said biasing means to release said latched releasable means.

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